DOCUMENT RESUME

ED 135 581 SE 021 572

AUTHOR	Zdravkovich, V.
TITLE	Organic Chemistry Self Instructional Package 1: Review of General Chemistry.
INSTITUTION	Prince George's Community Coll., Largo, Md.
PUB DATE	76
NOTE	25p.; For related Packages 2-17, see SE 021 573-588; Not available in hard copy due to copyright restrictions
AVAILABLE FROM	Prince George's Community College Bookstore, Largo, Maryland 20870 ($17.00 a set, $1.00 ea.)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Autoinstructional Aids; *Chemistry; *College Science; Higher Education; *Independent Study; Individualized Instruction; Individualized Programs; *Organic Chemistry; Science Education; Self Help Programs
IDENTIFIERS	Carbon; Prince Georges Community College

ABSTRACT

This booklet is one of a series of 17 developed at Prince George's Community College, Largo, Maryland. It provides an individualized, self-paced undergraduate organic chemistry instruction module designed to augment any course in organic chemistry but particularly those taught using the text "Organic Chemistry" by Morrison and Boyd. The entire series of modules covers the first 13 chapters of the Morrison-Boyd text in great detail. Each module has been provided with from one to three audiotapes, available from Prince George's Community College, to provide students additional explanations of particular concepts. Each module includes a self-evaluation exercise, a reference guide, worksheets to be completed with the audiotapes, answer sheets for the worksheets, a progress evaluation, an answer sheet for the progress evaluation, an answer sheet for the self-evaluation exercise, an introduction to the topic covered by the module, and student performance objectives for the module. The topic of this module is a review of general chemistry, particularly the hybridization of the carbon atom. (SL)

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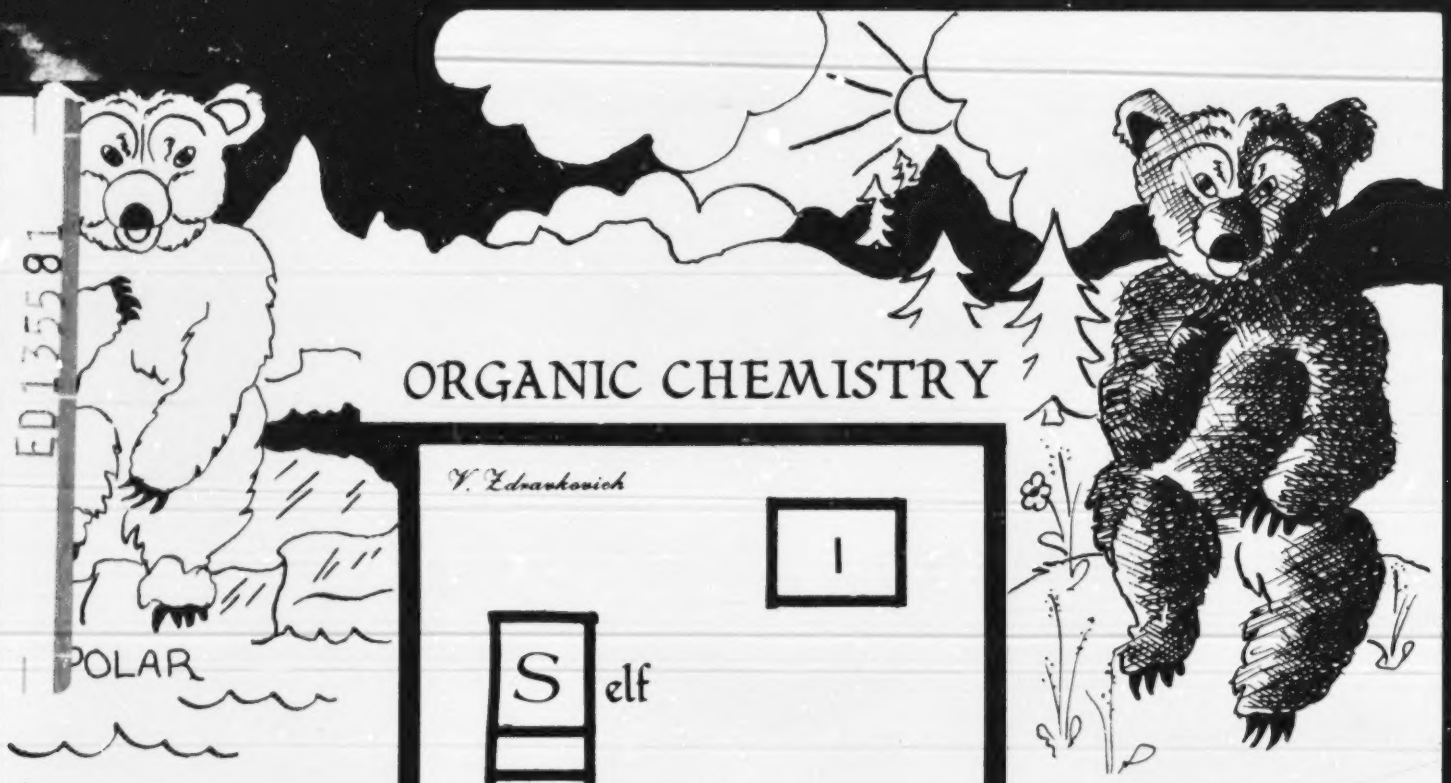

ORGANIC CHEMISTRY

V. Zdravkovich

1

Self

Instructional

Package

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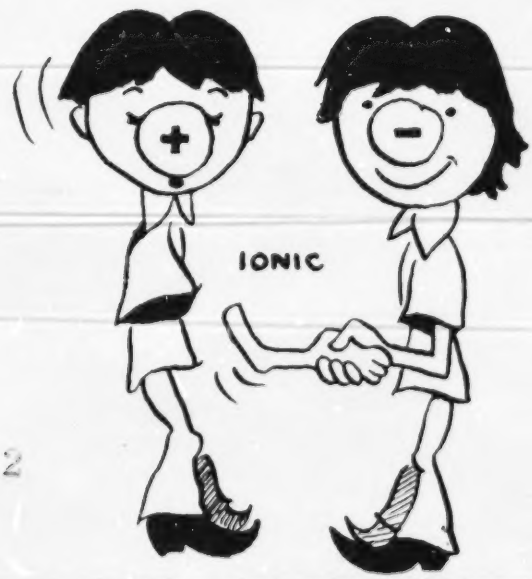
REVIEW OF GENERAL CHEMISTRY



SE 021 572

Self Instructional Sequence in

ORGANIC CHEMISTRY

"Copr.," V. Zdravkovich 1976

ORGANIC CHEMISTRY - CHEM. 201

MAJOR TEXTBOOK: Organic Chemistry - Morrison and Boyd

SUPPLEMENTARY TEXTBOOKS: The Names and Structure of Organic Compounds - Otto T. Benfrey

INTRODUCTION

Organic compounds are compounds we are most intimately associated with. We wear cloth made of organic compounds; we write on paper which in itself is a vast treasury of organic compounds; the list of examples is endless. I enumerated only a few.

Organic compounds are the subject of the branch of Chemistry called organic chemistry. Organic chemistry can be defined as a chemistry of carbon compounds. To an ignorant reader this statement may appear pretentious or unprecise. One may question this definition remembering that there are 106 other elements in addition to carbon. Does this mean that each element and its compounds comprises an entire branch of chemistry? Or, is it true only in the case of the representative elements? This and many other questions will have their answer in this course.

The field of organic chemistry is immense. Many branches such as photochemistry, free radical chemistry, polymer chemistry, physical organic chemistry, chemistry of heterocyclic compounds were derived from it. It takes a lifetime to master it all.

Organic chemistry is approximately one and a half centuries old. It was sired by Friedrich Wohler in 1828 when he performed the first synthesis of an organic compound. He synthesized urea from ammonium cyanate. Until that time organic compounds were only found and isolated from naturally occuring substances. Until 1828 organic chemistry was "vegetable chemistry". A new era began with Wohler's discovery as evidenced by the letter written by Berzelius to Weber.

> *"The conclusions which you have drawn from the investigation of bitter-almond oil, are certainly the most important which have so far been reached in the domain of vegetable chemistry, and give promise of shedding an unexpected light over this part of the science....The facts which you have set forth inspire such reflections that they may be regarded as the dawn of a new day in vegetable chemistry."*

The object of this course is to invite you to enter and explore this primeval forest and learn about the basic organic formulas and compounds.

Self Instructional Package No. 1
Form A - List of Objectives

Review of General Chemistry

Hybridization on the Carbon Atom

Definitions

The student will be able to define or describe and illustrate with appropriate examples where applicable the following terms: ELECTRONEGATIVITY, ATOMIC ORBITAL, s A.O., p A.O., d A.O., IONIC BOND, COVALENT BOND, NONPOLAR COVALENT BOND, POLAR COVALENT BOND, COORDINATE COVALENT BOND, BOND ANGLE, BOND LENGTH, BOND STRENGTH, BOND DISSOCIATION ENERGY, HYBRIDIZATION, sp^3 HYBRID ORBITALS, INTERMOLECULAR FORCES, VAN DER WAALS FORCES, POLARITY OF MOLECULES, SOLUBILITY, BOILING POINT, MELTING POINT, BRONSTED BASE, BRONSTED ACID, LEWIS ACID, LEWIS BASE.

Concepts

The student will be able to identify a bond as polar or nonpolar.

The student will be able to identify a bond as ionic or covalent.

The student will be able to identify the number of valence electrons in any representative element.

The student will be able to write the ground state electron configuration for the following elements: H, C, N, O, He, Ne.

The student will be able to write and explain the two steps in the sp^3 hybridization on the C atom.

The student will be able to identify the atomic orbitals revolved in bond formation.

The student will be able to explain the different polarities of some bonds based on the electronegativities of the atoms involved.

The student will be able to determine the relative strength of the given bonds from their length values.

The student will be able to predict the relative values for the boiling and melting points from their molecular weights or intermolecular forces.

The student will be able to predict the relative solubilities of the given compounds in different solvents.

The student will be able to identify the Bronsted acid and the Bronsted base as well as the Lewis acid and the Lewis base in a given reaction.

Self Instructional Package No. 1
Form B - Self-Evaluation Exercise

Review of General Chemistry

Hybridization on the Carbon Atom

Fill out this exercise by blacking the appropriate answers. Remember, when more than one answer is required, blacken all the appropriate ones. You will then score the exercise yourself.

(1) Organic Chemistry is the Chemistry of carbon compounds. C is in Group IV and has atomic number 6, and atomic mass 12. Therefore, which of the following statements about the carbon atom are NOT correct?

a) Carbon has 6 electrons, 12 neutrons, and 6 protons.
b) Carbon has 6 electrons, 6 neutrons, and 6 protons.
c) Carbon has 6 valence electrons.
d) Carbon has 2 electrons in the p atomic orbitals in the ground state configuration.

(2) The members of a "Family" or "Group" of elements in the periodic table will have the same:

a) atomic number.
b) electronegativity.
c) number of electrons beneath the outermost shell.
d) number of electrons in the outermost shell.

(3) Which of the following statements is/are NOT true?

a) Electronegativity is the attraction of an atom for shared electrons.
b) Ionization potential is the energy liberated when an electron is removed from an atom in the gaseous state.
c) Maximum overlap of atomic orbitals results in the strongest bond.
d) Nonmetals have in general high electronegativity.

(4) Which of the statements given below about the atomic orbitals is/are NOT correct?

a) All energy levels possess the same number of atomic orbitals.
b) Atomic orbitals have a definite shape.
c) Only two electrons can occupy any atomic orbital.
d) The region in space where an electron is most likely to be found is called an orbital.

(5) Which of the statements below is/are correct?

a) p atomic orbitals consist of two lobes with atomic nucleus between them.
b) s atomic orbital has the shape of a sphere with its center at the nucleus of the atom.
c) there are five p atomic orbitals in any given energy level.
d) there is one s atomic orbital in any given energy level.

(6) The following statements about the ionic bond are true:

a) an ionic bond exists between two nonmetals.
b) an ionic bond exists between a metal and a nonmetal.
c) an ionic bond results from the transfer of electrons.
d) an ionic bond is typical of the compounds of carbon.

(7) The transition from a normal covalent bond to an ionic bond occurs:

a) as a series of steps.
b) does not take place at all.
c) not sharply, but gradually.
d) sharply.

(8) A typical covalent bond can be defined as:

a) electrostatic attraction between two oppositely charged ions.
b) sharing of electrons between two atoms.
c) the Sigma σ molecular orbital formed through an overlap of two atomic orbitals.
d) none of the above.

(9) When two or more atoms of a certain nonmetal combine to form a polyatomic molecule, the bonding is:

a) covalent
b) ionic
c) nonpolar
d) polar

(10) Compounds formed by the combination of two nonmetals are:

a) nonconductors and are therefore covalent.
b) conductors and are therefore ionic.
c) nonconductors and are therefore ionic.
d) conductors and are therefore covalent.

(11) The following statements about the nonpolar covalent bond are correct:

a) It is the bond between two atoms with different electronegativity.
b) It is the bond between two atoms with same electronegativities.
c) In a nonpolar covalent bond the center of positive and the center of negative electron density coincide.
d) The electrons are not shared equally by the two atoms.

(12) In which of the following binary compounds are the bonds covalent?

a) C_6H_6 b) CCl_4 c) CaS d) NaBr

(13) In which of the following compounds are the bonds ionic?

a) K_2O b) CO_2 c) H_2O d) HCl

Blacken the proper space indicating for each compound whether the bond within it is covalent or ionic; polar or nonpolar:

a) covalent b) ionic c) nonpolar d) polar

(14) CH_4

(15) NH_4

(16) Na_2O

(17) H_2

(18) The greater the difference in the electronegativities of two elements, the strength of the bond between them will be:

a) depends on particular elements involved
b) greater
c) less
d) not affected

(19) What does a bond which is longer than expected suggest relative to its strength?

a) it is stronger than expected.
b) it is weaker than expected.
c) it suggest nothing.
d) no change in the strength.

(20) The length of the carbon-carbon bond in ethane is 1.53 Å; the length of carbon-carbon bond in ethylene is 1.34 Å. Which of the following statements about the bond dissociation energy of the compounds above is/are correct?

a) Bond dissociation energy of the carbon-carbon bond in ethane is higher than that of ethylene.
b) Bond dissociation energy of the carbon-carbon bond in ethane is lower than that of ethylene.
c) Bond dissociation energy of the carbon-carbon bond in ethane is the same as that in ethylene.
d) Bond dissociation energy of the carbon-carbon bond is not related to the length of the bond.

(21) The correct statement(s) below are:

a) Bond dissociation energy is the energy in kcal/mole needed to form the bond.
b) Bond length is the distance between the nuclei.
c) Each kind of covalent bond has a characteristic length and strength.
d) Sigma orbitals are cylindrically symmetrical about the internuclear axis.

(22) The following reaction: $H_3N:$ + $BF_3 \longrightarrow$ H N:BF represents formation of:

a) a coordinate covalent bond
b) a double bond
c) a hydrogen bond
d) an ionic bond

(23) Sigma σ molecular orbitals can be formed VIA:

a) overlap of s atomic orbitals only
b) overlap of s and p atomic orbitals
c) overlap of s and sp^3 atomic orbitals
d) none of the above.

(24) Which answer below best describes the formation of four equivalent, single covalent bonds by carbon in compounds like carbon tetrachloride CCl_4?

a) coordinate covalent bonding
b) hybridization
c) hydrogen bonding
d) sigma σ bonding.

(25) Which one of the statements below is NOT correct?

a) Hybrid orbitals cannot house nonbonding electrons.
b) Hybridization enables the electron pairs to get as far away from each other as possible.
c) Hybridization is accompanied by an increase in the directional character of the bonds.
d) Hybridization is an arrangement of atomic orbitals which results in the minimum intramolecular repulsion.

(26) Which of the following tetrahedral molecules would you expect to possess a dipole moment different from zero?

a) CCl_4 (carbon tetrachloride)

b) CH_4 (methane)

c) $CHCl_3$ (chloroform)

d) CH_2Br_2 (dibromomethane)

(27) For each one of the molecules given below the shape has been indicated. Identify all the nonpolar molecules.

a) BF_3 - flat-trigonal

b) CO_2 - linear

c) HCl - linear

d) NH_3 - pyramidal

(28) Intermolecular forces are:

a) electrostatic in nature
b) forces between electrons and nuclei of the same molecule
c) forces between individual molecules
d) forces within the given molecule

(29) Identify all the correct statements below:

a) The magnitude of intermolecular forces does not affect the boiling point.
b) Nonpolar solutes dissolve easily in water.
c) Polar solutes dissolve easily in polar solvents.
d) The stronger the intermolecular forces, the higher the boiling point.

(30) The property which is NOT characteristic of nonpolar compounds is:

a) good solubility in nonpolar solvents.
b) good solubility in water.
c) low dipole moment.
d) low melting and boiling temperature.

(31) Benzene is a typical nonpolar organic solvent. The solubility of octane C_8H_{18} (a nonpolar organic compound) in benzene would be expected to be:

a) about the same as the solubility of octane in water.
b) higher than the solubility of octane in water.
c) impossible to determine from facts given.
d) lower than the solubility of octane in water.

(32) Water H_2O and methane CH_4 have very similar molecular weights (18 and 16 respectively), yet the normal boiling point of water is 100°C and that of methane is -161.5°C. This is explained by the fact that:

a) hydrogen boinding takes place in water.
b) the intermolecular forces in methane are considerably stronger than the intermolecular forces in water.
c) the intermolecular forces in water are considerably stronger than the intermolecular forces in methane.
d) water has a very low dipole moment.

(33) Methane CH_4 (molecular weight 16) and carbon tetrafluoride CF_4 (molecular weight 88) are both nonpolar compounds. The following prediction can be made about their boiling points:

a) The boiling point of methane will be higher than that of carbon tetrafluoride.
b) The boiling point of methane will be lower than that of carbon tetrafluoride.
c) The boiling points will be very close.
d) The boiling points of each will vary depending upon volume of each compound.

(34) A base in the Bronsted-Lowry sense is:

a) a proton acceptor
b) a hydroxide ion donor
c) an electron pair acceptor
d) an electron pair donor

(35) A "Lewis Acid" is:

a) a proton acceptor
b) a proton donor
c) an electron pair acceptor
d) an electron pair donor

(36) In the neutralization reaction given below, phenol C_6H_5OH acts as:

$$C_6H_5OH + NaOH \rightleftharpoons C_6H_5O^-Na^+ + H_2O$$

a) a "Bronsted acid"
b) a hydroxide ion donor
c) a Lewis base
d) a proton donor

(37) In the following reaction: $C_2H_5\ddot{O}H + H^+ \rightarrow C_2H_5\overset{H}{\underset{\cdot}{\ddot{O}}}H^+$ ethyl alcohol

(C_2H_5 OH):

a) donates electrons to the hydrogen ion.
b) exhibits behavior typical of a Bronsted base.
c) exhibits behavior typical of a Lewis acid.
d) exhibits behavior typical of a Lewis base.

(38) In the following reaction: $HCl + NaHCO_3 \rightarrow H_2CO_3 + NaCl$

a) HCl is a Bronsted acid.
b) H_2CO_3 is a weaker acid.
c) $NaHCO_3$ is a Bronsted base.
d) $NaHCO_3$ is a Lewis acid.

Self Instructional Package No. 1
Form C - Reference Guide

Review of General Chemistry
Hybridization on the Carbon Atom

The reference guide should be used in conjunction with Form B or the Self Evaluation Exercise. The references given are geared specifically toward the questions on Form B.

Questions 1, 2	Chapter 1	Section 6
Question 3	Chapter 1	Section 15
Questions 4,5	Chapter 1	Sections 4, 5
Questions 6, 7, 9, 12, 13, 14, 15, 16, 17	Chapter 1	Sections 3, 8
Questions 10, 11 12, 18	Chapter 1	Sections 8, 15
Questions 20, 21	Chapter 1	Sections 13, 14
Questions 18, 19	Chapter 1	Section 8
Question 23	Chapter 1	Sections 7, 8
Questions 24, 25	Chapter 1	Sections 9, 11, 12
Question 26	Chapter 1	Section 16
Question 28	Chapter 1	Section 19
Questions 29, 30, 31	Chapter 1	Sections 17, 18, 19, 20, 21
Questions 32, 33	Chapter 1	Section 20
Questions 34, 35, 36, 37, 38	Chapter 1	Section 22

Morrison and Boyd Organic Chemistry

For Questions 23, 24, and 25, additional explanation and examples can be found in Tape 1 - sp^3 Hybridization on the Carbon Atom.

Material to supplement the topics covered in this Self Instructional Package can be found in any General Chemistry text book.

Learn as though you would never be able to master it; hold it as though you would be in fear of losing it.
Confucius (6th. B.C.)

sp^3 Hybridization on the carbon atom.

Example No. 1

Ground state configuration of the carbon atom is:

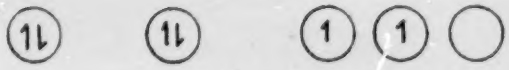
C $1s^2$ $2s^2$ $2p^2$

or

(dots represent electrons)

1s 2s 2p

or



(arrows represent electrons)

Example No. 2 - Sp^3 Hybridization

C

(two unpaired electrons)

1s 2s 2p

Step 1 _ promotion of one s electron from the 2s atomic orbital into the 2p atomic orbital.

1s 2s 2p

C

(four unpaired electrons)

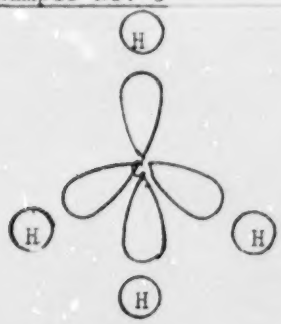
Step 2 - mixing of one S A.O. and three p A.O's to yield four equivalent sp^3 A.O.'s.

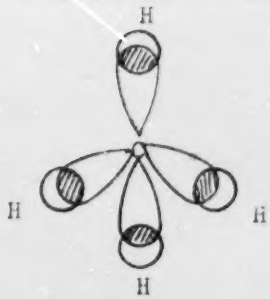
sp^3 A.O.'s

C

SIP No. 1
Tape 1 - Work Sheet

Example No. 3





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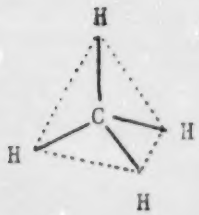

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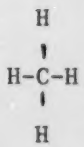


Assignment No. 1

Consider the molecule of carbontetrachloride with the formula of $C Cl_4$. Complete the following statements:

a) The shape of CCl_4 is _____.

b) The bond angles in CCl_4 are equal to _____.

c) The C-Cl bond is polar or nonpolar. _____.

d) The C-Cl bond is covalent or ionic _____.

e) The bond between carbon and chlorine in CCl_4 is the result of the overlap of the _____ atomic orbital on carbon and _____ atomic orbital on chlorine.

f) Draw the Lewis electron dot symbol of CCl_4

SIP No. 1
Tape 1 - Work Sheet

Assignment No. 2

Identify the following statements related to bromoform CH_3Br as True or False.

a) The shape of the bromoform molecule is tetrahedral _____.

b) All the bonds in bromoform are identical _____.

c) All the bonds in bromoform are nonpolar _____.

d) All the bonds in bromoform are covalent _____.

e) The atomic orbitals on the carbon atom involved in formation of the bonds are one s and three p A.O.'s. _____.

Assignment No. 3

The angles in ammonia NH_3 are nearly tetrahedral (107°) rather than 90° as could be expected. The natural conclusion is that the atomic orbitals on nitrogen in ammonia are sp^3 hybrid orbitals.

a) Explain the hybridization on N in ammonia.

b) Draw the Lewis electron dot symbol for ammonia.

c) The nonbonding electrons in ammonia are located in the _____ atomic orbital.

d) Draw the Lewis electron dot symbol for the ammonium ion NH_4^+.

e) Predict the shape of the ammonium ion.

Self Instructional Package No. 1
Tape 1 - Answer Sheet

Sp^3 Hybridization on the carbon atom

Assignment No. 1

a) tetrahedral

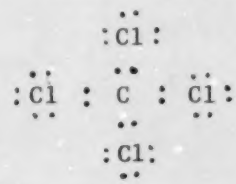
b) $\sim 109°$

c) polar (chlorine is considerably more electronegative than carbon)

d) covalent (bond between two nonmetals.

e) sp^3 A.O. on carbon and p A.O. on chlorine

f)



Assignment No. 2

a) T

b) F

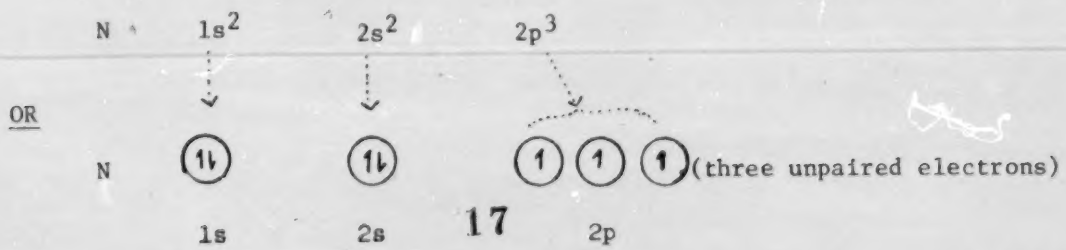
c) F

d) T

e) F

Assignment No. 3

a) Ground state configuration on N is:

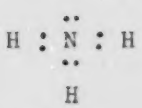


SIP No. 1
Tape 1 - Answer Sheet

Assignment No. 3 (continued)

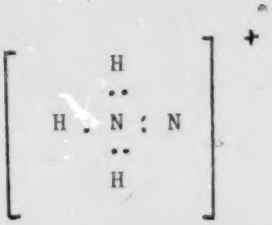
a) sp^3 hybridization in case of N consists of mixing of one s A.O. and three p A.O.'s

b)



c) Sp^3 A.O.

d)



e) tetrahedral

Self Instructional Package No. 1
Form D - Progress Check Evaluation

Review of General Chemistry

Hybridization on the Carbon Atom

Identify the statements below as True or False by placing a Capital T or F in the space to the left.

1. _____ sp^3 hybridization results from the mixing of one s A.O. and three p A.O.
2. _____ The sp^3 atomic orbitals are directed toward the corners of a pyramid.
3. _____ There are five p atomic orbitals in any given energy level.
4. _____ Any given atomic orbital can house a maximum of two electrons.
5. _____ The overlap of the s A.O. on element A and p A.O. on element B results in the formation of a σ molecular orbital.
6. _____ Maximum overlap of atomic orbitals results in the strongest bond.
7. _____ Oxygen is more electronegative than carbon.
8. _____ Chlorine is less electronegative than carbon.
9. _____ The transition from a normal covalent bond to an ionic bond occurs sharply.
10. _____ Compounds formed by the combination of two nonmetals are non-conductors of electricity.

Blacken the correct answer or answers in the questions below:

11. Oxygen has atomic number 8 and atomic mass 16. The correct number of subatomic particles in oxygen is:

a)	8 electrons	8 protons	8 neutrons
b)	8 electrons	16 protons	16 neutrons
c)	16 electrons	16 protons	8 neutrons
d)	8 electrons	8 protons	16 neutrons

12. Identify the correct statements about a covalent bond.

a) It is a M.O. formed via overlap of two A.O's.
b) It can be defined as sharing of electrons between two atoms.
c) It can be defined as the electrostatic attraction between atoms.
d) Covalent bond has characteristic length and bond dissociation energy.

Identify the bonds in each compound in the following five questions as:
a) covalent b) ionic c) nonpolar d) polar.

13. C_2H_6

14. O_2

15. H_2O

16. Na_2O

17. NH_3

18. A shorter than expected bond between two elements indicates that:

a) it is stronger than expected.
b) it is weaker than expected.
c) it has a higher than expected bond dissociation energy.
d) it suggests nothing.

19. The length of the carbon-carbon bond in ethylene is 1.34Å; the length of carbon-carbon bond in acetylene is 1, A. Identify the correct statements relative to these two compounds.

a) Bond dissociation energy of the carbon-carbon bond in ethylene is higher than that of acetylene.
b) Bond dissociation energy of the carbon-carbon bond in ethylene is lower than that of acetylene.
c) Carbon-carbon bond in acetylene is stronger than the carbon-carbon bond in ethylene.
d) Bond dissociation energy of the carbon-carbon bond is not related to the length of the bond.

20. Identify the correct statements below:

a) Overlap of s A.O. on element A and sp^3 A.O. on element b results in the formation of σ M.O.
b) Mixing of an s A.O. and three p A.O. on the same element results in the formation of σ M.O.
c) Hybridization results in the minimum intramolecular repulsion.
d) Hybridization is accompanied by an increase in the directional character of the bonds.

21. The ammonium ion is symmetrical. The nitrogen is at the center of a tetrahedron and four equivalent hydrogens are in the corners of the tetrahedron. The bonding in the ion may best be described as resulting from the overlap of the s atomic orbitals in the hydrogens and:

a) one s and three p atomic orbitals in nitrogen.
b) the p atomic orbitals in nitrogen.
c) the s atomic orbitals in nitrogen.
d) sp^3 hybrid orbitals in nitrogen.

22. All the molecules below are tetrahedral. Identify the ones that have a dipole moment equal to zero.

a) CBr_4

b) $CHBr_3$

c) CH_3Br

d) CH_4

23. Identify the correct statements below:

a) The magnitude of the Van der Waals forces increases with an increase in the molecular weight.
b) The increase in molecular weight implies a higher boiling point.
c) The stronger the intermolecular forces, higher the boiling point.
d) The magnitude of intermolecular forces has no effect on the boiling point.

24. The following represent typical examples of intermolecular forces:

a) dipole-dipole interactions
b) hydrogen bonding
c) magnetic attractions
d) Van Der Waals forces.

25. Octane C_8H_{18} and methane CH_4 are both nonpolar organic molecules. From their molecular formulas one could predict that:

a) octane has higher boiling point than methane.
b) octane is soluble in a nonpolar organic solvent.
c) methane is soluble in water.
d) methane has higher boiling point than octane.

26. Methane CH_4 and ammonia have very similar molecular weights yet the boiling point of ammonia is _____°C and the boiling point of methane is -161.5°C. These experimental values indicate that:

a) the intermolecular forces in methane are weaker than those in ammonia.
b) ammonia is probably a polar molecule.
c) the intermolecular forces in methane are stronger than those in ammonia.
d) that ammonia has a lower dipole moment than methane.

27. The fact that water is such a good solvent for so many ionic compounds is due to:

a) hydrogen bonding in water.
b) the ability of water to solvate (hydrate) both cations and anions.
c) the high boiling point of water.
d) the small amount of dissociation in pure water.

28. Ethyl alcohol and dimethyl ether have the same molecular weight. Ethyl alcohol is polar and dimethyl ether is nonpolar. What could you predict relative to their boiling points?

a) The boiling point of alcohol will be higher than that of ether.
b) The boiling point of alcohol will be lower than that of ether.
c) The boiling points cannot be compared from facts given.
d) They will have the same boiling point.

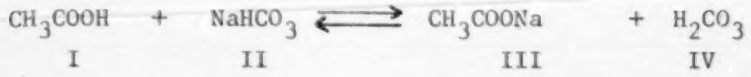
29. A Bronsted-Lowry acid is:

a) a proton donor.
b) a proton acceptor.
c) an electron donor.
d) an electron acceptor.

30. A "Lewis Base" is:

a) a proton acceptor.
b) a hydroxide donor.
c) an electron pair donor.
d) an electron pair acceptor.

31. In the neutralization reaction below compound I acts as:

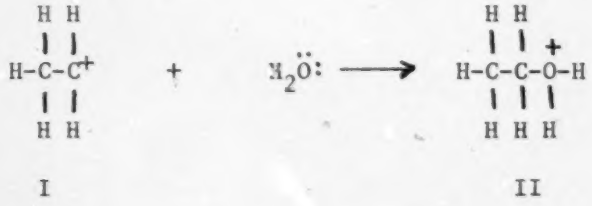


a) Lewis acid.
b) Lewis base.
c) Bronsted acid.
d) Bronsted base.

32. The correct statements about the neutralization reaction in question (31) is:

a) I is a stronger acid than IV.
b) I replaces a weaker acid IV.
c) I is a weaker acid than IV.
d) I donates proton to II.

33. The correct statements related to the reaction below are:



a) I acts as electron acceptor.
b) water acts as an electron donor.
c) the bond between C and O is a coordinate covalent bond
d) I donates electrons to water.

Self Instructional Package No. 1
Form B[1] - Self-Evaluation Exercise - Answers

Review of General Chemistry

Hybridization on the Carbon Atom

1.	a, c	20.	b
2.	d	21.	b, c, d
3.	b	22.	a
4.	a	23.	a, b, c
5.	c	24.	b
6.	b, c	25.	a
7.	c	26.	c, d
8.	b, c	27.	a, b
9.	a, c	28.	a, c
10.	a	29.	c, d
11.	b, c	30.	b
12.	a, b	31.	b
13.	a	32.	a, c
14.	a, d	33.	b
15.	a, d	34.	a
16.	b	35.	c
17.	a, c	36.	a, d
18.	c	37.	a, b, d
19.	b	38.	a, b, c

Self Instructional Package No. 1
Form D^1 - Progress Echk Evaluation - Answers

Review of General Chemistry

Hybridization on the Carbon Atom

1.	T	11.	a	21.	d	31.	c
2.	F	12.	a, b, d	22.	a, d	32.	a, b, d
3.	F	13.	a, d	23.	a, b, c	33.	a, b, c
4.	T	14.	a, c	24.	a, c, d		
5.	T	15.	a, c	25.	a, b		
6.	T	16.	b	26.	a, b		
7.	T	17.	a, d	27.	b		
8.	F	18.	a, c	28.	a		
9.	F	19.	b, c	29.	a		
10.	T	20.	a, c, d	30.	c		